Claims

What is claimed is:

1. An engine valve actuation system, comprising:

an engine valve movable between a first position where the engine valve prevents a flow of fluid and a second position where the engine valve allows a flow of fluid;

a cam assembly operatively connected to the engine valve to move the engine valve between the first position and the second position in a predetermined actuation pattern;

a valve actuator having a piezo electric device, and being operable to change the movement of the engine valve from the predetermined actuation pattern; and

a controller adapted to control the piezo electric device to achieve a desired valve actuation pattern.

2. The valve actuation system of claim 1, wherein the valve actuator further includes:

an actuator housing defining a bore;

a piston slidably disposed in the bore of the actuator housing and adapted to engage the engine valve; and

a fluid passageway pressurized by the piezo electric device to thereby cause movement of the piston.

3. The valve actuation system of claim 2, further including a second fluid passageway pressurized by a second piezo electric device arranged such that force generated by the second piezo electric device opposes movement caused by the first piezo electric device to move the piston in a direction opposite the movement initiated by the first piezo electric device.

4. The valve actuation system of claim 1, further including:

an actuator housing defining a bore; and

a piston slidably disposed in the bore of the actuator housing, the piston adapted to move between a first position and a second position where the piston moves into operative connection with the engine valve.

5. The valve actuation system of claim 4, further including:

a tank adapted to store a supply of fluid;

a source of fluid in communication with the tank and the bore of the actuator housing; and

a control valve disposed between the bore in the actuator housing and the tank, the control valve being moveable by a piezo electric device between a first position where fluid is allowed to flow between the source and the bore and a second position where fluid is prevented from flowing between the source and the bore to trap fluid in the bore, the trapped fluid preventing the piston from moving with respect to the actuator housing to thereby prevent the engine valve from returning to the first position.

6. The valve actuation system of claim 5, including a return spring adapted to move the control valve in a direction opposite the movement initiated by the first piezo electric device.

7. The valve actuation system of claim 5, further including a second opposing piezo electric device for moving the control valve in a direction opposite the movement initiated by first piezo electric device.

8. The valve actuation system of claim 5, further including a snubbing valve adapted to slow a seating velocity of the piston.

9. The valve actuation system of claim 5, further including:

an accumulator disposed in the actuator housing, the accumulator in fluid connection with the source of fluid and the bore;

a restrictive orifice disposed at the inlet to the accumulator; and

a check valve disposed in the fluid line between the source of fluid and the actuator housing.

10. The valve actuation system of claim 5, further including a mechanical biasing element acting on the piston to move the piston towards the second position.

11. The valve actuation system of claim 4, wherein the piezo electric device directly contacts the piston to thereby move the piston.

12. The valve actuation system of claim 11, further including a second opposing piezo electric device for moving the piston in a direction opposite the movement initiated by the first piezo electric device.

13. The valve actuation system of claim 1, further including a position sensor operable to sense the position of the engine valve.

14. A method of actuating an engine valve, comprising:

operating a cam assembly to move an engine valve in a predetermined actuation pattern between a first position where the engine valve blocks a flow of fluid and a second position where the engine valve allows a flow of fluid;

operating a valve actuator having at least one piezo electric device, the valve actuator adapted to change the movement of the engine valve from the predetermined actuation pattern; and

controlling the at least one piezo electric device to achieve a desired valve actuation pattern.

15. The method of claim 14, including:

pressurizing a fluid with the at least one piezo electric device; and

directing the pressurized fluid to a piston which engages the engine valve.

16. The method of claim 14, further including extending a piston from an actuator housing to selectively engage the engine valve.

17. The method of claim 16, including:

directing a flow of fluid from a source into a bore in the actuator housing associated with the piston; and

applying a voltage to a piezo electric device to close a control valve, thereby preventing fluid from flowing from the bore to trap the fluid, preventing the piston from moving with respect to the actuator housing.

18. The method of claim 17, further including applying a voltage to a second opposing piezo electric device to open a control valve, thereby allowing fluid to flow from the bore to release the piston and allow the engine valve to return to the first position.

19. The method of claim 17, wherein fluid is allowed to flow from the bore after a predetermined period of time to achieve the desired valve actuation pattern.

20. The method of claim 17, further including directing a flow of fluid from the bore to an accumulator.

21. The method of claim 16, further including mechanically connecting the at least one piezo electric device directly to the piston to move the piston and rocker arm.

22. An engine comprising:

an engine block, defining at least one cylinder;

an engine piston slidably disposed within the at least one cylinder;

an engine valve associated with the at least one cylinder moveable between a first position where the engine valve prevents a flow of fluid relative to the at least one cylinder and a second position where the engine valve allows a flow of fluid relative to the at least one cylinder;

a cam assembly operatively connected to the engine valve to move the engine valve between the first position and the second position in a predetermined pattern;

a crankshaft operatively connected to the piston and the cam assembly providing timing synchronization between the engine piston and the cam assembly;

an engine valve actuator having a piezo electric device and being operable to alter the movement of the engine valve from the predetermined pattern; and

a controller adapted to control the valve actuator to achieve a desired valve actuation pattern.

23. The engine of claim 22, wherein the valve actuator further includes:

an actuator housing defining a bore;

a piston slidably disposed in the bore of the actuator housing and adapted to engage the engine valve; and

a fluid passageway pressurized by the piezo electric device to thereby cause movement of the piston.

24. The engine of claim 23, further including a second fluid passageway pressurized by a second piezo electric device arranged such that force generated by the second piezo electric device opposes movement caused by first piezo electric device to move the piston in a direction opposite the movement initiated by the first piezo electric device.

25. The engine of claim 23, including:

an actuator housing defining a bore; and

a piston slidably disposed in the bore of the actuator housing, the piston adapted to move between a first position and a second position where the piston selectively engages an engine valve.

26. The engine of claim 25, including:

a tank adapted to store a supply of fluid;

a source of fluid in communication with the tank and the bore of the actuator housing; and

a control valve disposed between the bore in the actuator housing and the tank, the control valve being moveable by a piezo electric device between a first position where fluid is allowed to flow between the source and the bore and a second position where fluid is prevented from flowing between the source and the bore to trap fluid in the bore, the trapped fluid preventing the piston from moving with respect to the actuator housing to thereby prevent the engine valve from returning to the first position.

27. The engine as described in 26, including a return spring adapted to move the control valve in a direction opposite to the direction of movement caused by the piezo electric device.

28. The engine as in 26, further including a second opposing piezo device to move the control valve in a direction opposite to the direction of movement caused by the piezo electric device.

29. The engine of claim 26, further including a snubbing valve adapted to slow a seating velocity of the piston.

30. The engine of claim 26, further including:

an accumulator disposed in the actuator housing and in fluid connection with the fluid source and the bore;

a restrictive orifice disposed at the inlet to the accumulator; and

a check valve disposed in the fluid line between the source and the actuator housing.

31. The engine of claim 26, further including a mechanical biasing element acting on the piston to move the piston towards the second position.

32. The engine of claim 25, wherein the piezo electric device directly contacts the piston to thereby move the piston.

33. The engine of claim 32, further including a second opposing piezo device to move the piston in a direction opposite to the direction of movement caused by the piezo electric device.